

ANTA 602: Review

Be careful,
Here is Antarctica

—— the statistics and analysis of the
grave accidents in Antarctica

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1. Preamble

Imagine wind chills that freeze exposed skin in seconds, blizzards that reduce visibility to a few feet, months of darkness, and seemingly endless expanses of featureless snow and ice. Here is Antarctica, which is well known to have the lowest temperature, the strongest wind and the longest night in the world. Accordingly, it is one of the most dangerous places which have much accident in the history.

This essay lists the recorded grave accidents in Antarctica from two aspects. The first paragraph introduces the ancient accidents along the history of people's activities in this continent, with analyzing the reasons of them. The second part of the assoeted accidents subsequently emphasize some kinds of the severe accidents happened in Antarctica, also combing with the reason and ponderance investigation. The last paragraph summarizes the safety precautions from these grave accidents.

2. Historical grave accidents in Antarctica

For the early explorers, survival in Antarctica meant a constant struggle against the elements, a struggle which resulted in many paying the ultimate cost.

2.1 Nautical explorers

It is recorded that the first to die in Antarctica were the Spanish officers, soldiers and seamen on board the San Telmo, which sank in September 1819. The San Telmo commanded by Captain Rosendo Porlier was the flagship of a Spanish naval squadron bound for Callao (Peru) to reinforce colonial forces there fighting the independence movements in Spanish America. Damaged by severe weather in the Drake Passage, south of Cape Horn, it sank off in September 1819.

The 644 officers, soldiers and seamen lost onboard the San Telmo were the first people to die in Antarctica, as parts of her wreckage were found months later by the first sealers who reached Livingston Island. Indeed, if somebody of the San Telmo survived to set foot there he would be the first man in history to reach Antarctica. There is a cairn commemorating this at Half Moon Beach, Cape Shirreff, Livingston Island, and South Shetland Islands.

2.2 Heroic age

The Heroic Age of Antarctic Exploration describes an era which extended from the end of the 19th century to the early 1920s. During this period the Antarctic continent became the focus of an international effort which resulted in intensive scientific and geographical exploration, sixteen major expeditions being launched from eight different countries. The "heroic" label, bestowed later, recognised the adversities which had to be overcome by these pioneers, some of whom did not survive the experience.

During this period, it is recorded that 13 expedition members died on or near the Antarctic continent. Of these, three perished of illnesses; four fell into ice precipice, ice crease or sea ice; six died of Starvation and cold. See the Table1 below.

Date	Place	Name	Country	Cause of death
14 October, 1899	Cape Adare	Nikolai Hansen	Norway	Intestinal disorder
11 March, 1903	Ross Island	George Vince	UK	Slipped over ice precipice
18 February, 1912	Beardmore Glacier	Edgar Evans	UK	Starvation and cold
17 March, 1912	Great Ice Barrier	Lawrence Oates	UK	Starvation and cold
29 March, 1912	Great Ice Barrier	Robert Falcon Scott	UK	Starvation and cold
29 March, 1912	Great Ice Barrier	Edward Wilson	UK	Starvation and cold

29 March, 1912	Great Ice Barrier	Henry Bowers	UK	Starvation and cold
8 August, 1912	Weddell Sea	Richard Vahsel	Germany	Syphilis(disease)
14 December, 1912	King George V Land	Belgrave Ninnis	UK	Fell into crevasse
7 January, 1913	King George V Land	Xavier Mertz	Switzerland	Food poisoning
9 March, 1916	Ross Ice Shelf	Arnold Smith	UK	Cold and scurvy
8 May, 1916	McMurdo Sound	Aeneas Mackintosh	UK	Fell through sea ice
8 May, 1916	McMurdo Sound	Victor Hayward	UK	Fell through sea ice

Table 1 Explorers died in Heroic Age of Antarctic Exploration

The well-known story of Robert Falcon Scott in the South Pole is the biggest accident happened in this era. Scott's team arrived at the South Pole on January 17, 1912, only to discover that Norwegian explorer Roald Amundsen had taken a shorter route and beaten them by a month. As he had written in his journal: "All the daydreams must go. Now for the run home and a desperate struggle." Scott made two chief mistakes: To haul supplies on sledges, he relied on ponies, whose legs sank in the snow, instead of dogs. And he took four companions, rather than three as he had originally planned. AS a result the food was inadequate, especially in the low temperatures area where Scott was in. One by one, Scott's team members met their demise. Edward Evans died of injuries suffered when he fell down a crevasse. Lawrence Oates, believing he was slowing the team, gallantly disappeared into a blizzard. Scott, Edgar Wilson, and

Henry Bowers were twenty kilometers from a supply depot when a blizzard stranded them, condemning them to death. The final diary of Robert Falcon Scott was written on March 29, 1912.



Figure 1 Scott's group in the South Pole

2.3 Mechanized age

The Mechanized Age saw the rise of the use of technology in Antarctic exploration and scientific research. Improvements in technology, particularly in the communication and clothing, reduce the possibility of death in Antarctica for the reasons of Starvation and cold. Meanwhile machines provide the main form of surface transportation, taking over from skiing, manhauling and dog sledging, which also decrease the danger of slipping to the ice precipice and sea ice. But the development of the technology also brings mechanized accidents, such as the air crash accidents in the following paragraph 3.2.

2.4 Scientific age

The year 1957 marked a watershed in the history of Antarctic exploration, for it was then that the International Geophysical Year (IGY) began, which triggered an

eighteen-month year of Antarctic science. The International Council of Scientific Unions, a parent body, broadened the proposals from polar studies to geophysical research. More than 70 existing national scientific organizations then formed IGY committees to participate in the cooperative effort, and many Antarctic research stations were established in succession. Till now, about 30 countries have built more than sixty-five stations on the Antarctic mainland and peninsula.

From an international comparative study (October 2005) at 18 stations of 13 nations, which include one station respectively of Argentina, Brazil, Germany, France, France/Italy, Japan, Korea, Norway, South Africa and United States; two stations of China; and three stations respectively of Australia and United Kingdom. There have been 18 deaths at 9 Stations, which are listed in the table below.

Cause of death	Number of deaths
Fall into sea ice/crevasse	5
Lost-position due to bizzard	5
Helicopter crash	3
Drowning	2
Acute myocardial infarction	2
Explosion	1

Table 2 Death cases and their causes

Most of these cases were accidental deaths, compared with only 2 were caused by diseases. Although it is incomplete surveys which haven't cover all the stations in Antarctica, it can reveal the major causes of the casualties in the Antarctic science researches.

It is recorded that, compared to other countries, Russia (including the former Soviet Union) has the most decedents in Antarctic expedition, the number of which had reached 82 on September, 2005. Following is the United States, which lost more than 50 members in Antarctica since its modern expeditions. Both these countries have given the most devotion in Antarctic research, which also means the risk of going to Antarctica.

3. Assorted accidents

3.1 Fire

With the very unlikely exception of some exposed coal seams somehow catching fire there is really nothing at all in Antarctica that is naturally there that could burn. There is some vegetation, but nothing more than mosses, lichens and sparse growth of grass in a few places. There are no wild land fires in Antarctica. Despite the general lack of combustible materials, Antarctica is a very dangerous place to have a fire, which is one of the greatest dangers in Antarctica. The cold temperatures make it very dry, as the windiest place on earth there is likely to be a wind blowing a gale much of the time more than strong enough to fan the flames. Finally, due to the temperature averaging below freezing across the whole continent if there is a fire, then there is unlikely to be very much liquid water to fight it with. As Antarctica is such an extreme environment and so remote from any chance of help or rescue, the prospect of a station being gutted means not only the loss of the building/s, but also possibly the loss of “life support”.

The first recorded fire in Antarctica happened during the 1898-1900 British Antarctic Expedition led by Carsten E. Borchgrevink, aboard the Southern Cross. A member of the expedition set fire to his mattress during the winter nearly burning down the hut. If this had happened it could have led to the death of all members of the expedition with the loss of supplies and shelter. The other records are shown in the following table.

Date	Station	Building/s	Casualties	Cause	Condition
1958	Mawson, Australia	Main power house	no data available	no data available	Burnt down during construction
3 April, 1959	Mawson, Australia	Main power house	no data available	no data available	Burnt down
September, 2001	Rothera, UK	Bonner marine laboratory	none	electrical fault	Building destroyed
5 October, 2008	Progress, Russia	2 story Lodging House	1 killed, 2 seriously injured	electrical fault	Building and radio equipment destroyed
May, 2009	Scott, NZ	A frame hut	none	re-ignition of heater	Building destroyed

Table 3 Fire in Antarctica

The fire of Russian Progress Station broke out at wee hours of Sunday, when some of the 29 members are sleeping in this two-story lodging house. Most people broke the windows of their rooms to jump out from the burning building, which cause many wounds on the hands and legs, even two with serious fractures and internal injuries. The decedent is a construction worker, who didn't escape from the burning room. It was said that he had some drink before sleep. The personnel on the base at the time were unable to cope with the fire and the building was completely destroyed by the fire. And the radio equipments were also destroyed, which made it impossible to contact Russian officials about the incident until four days later. The injured received medical treatments in nearby Chinese Zhongshan Station, which also provided necessary material to Russia Progress Station.

According to the official declare of Russia, the fire was caused by an aging wire in the burning building. However, one member recalled that the fire began from the recreation room which didn't forbid smoking, and there were some people playing there before the disaster.



Figure 2 Fire in Russian Progress Station

3.2 Air crash

The development of aircraft and their subsequent use in Antarctica as the major technological development strongly influenced the course of exploration. But every advantage has its disadvantage, such as the air crashes in Antarctica. The Table below records some grave air crashes happened in Antarctica.

Date	Place	Fatalities/Survivors	Country/operator	Cause
30 December, 1946	Thurston Island	3 / 6	U.S. Navy	Severe weather
2 January, 1979	Molodyozhnay, Antarctica	4 / 3	Soviet Union, Aeroflot Il-14	engine failure
28 November, 1979	Mount Erebus, Ross Island	257 / 0	Air New Zealand	Pilot error
2 January, 1986	King George Island	10 / 0	Chilean crew with American tourist	Fog covered weather
9 December, 1987	East Antarctica	2 / 9	U.S. Navy	JATO bottle broke
13 October 1992	Near NZ-Scott Base	3 / 2	US Navy helicopter	Severe weather
9 January, 2001	Australian Casey station	0 / 2	Australia Squirrel helicopter	operational
17 January, 2003	Near US-McMurdo station	0 / 2	US-NSF helicopter	Unknown
20 December, 2007	Patterson, Antarctica	0 / 10	US-NSF DC-3	mechanical failure
2 March, 2008	Neumayer II base	2 / 3	German helicopter	Unknown
5 January, 2009	Russian Novolazarevskaya Station	0 / 4	Russia Enterprise Air	visibility dropped

Table 4 Grave air crashes in Antarctica

In these cases, the Mount Erebus accident is well-known as the most serious disaster in Antarctica. Air New Zealand Flight 901 was a scheduled Air New Zealand

Antarctic sightseeing flight that operated between 1977 and 1979, from Auckland Airport to Antarctica and return. On 28 November 1979, the fourteenth such flight, operated by a McDonnell Douglas DC-10-30, crashed into Mount Erebus on Ross Island, killing all 237 passengers and 20 crew on board. The accident report compiled by New Zealand's chief inspector of air accidents was released then. It cited pilot error as the principal cause of the accident and attributed blame to the decision of pilot to descend below the customary minimum altitude level, and continue at that height when the crew was unsure of the plane's position.



Figure 3 Part of the Flight 901's fuselage in Antarctica

However, the country suffered most from air crashes in Antarctica is United States, which had lost more than sixty planes. America has a strong ability of aircraft in Antarctica. It has the most airfields and aircrafts, which include C-17, LC-130, Twin Otter, A-star and C-130 for the Antarctic expedition. Now, the New York Air National Guard's 109th Airlift Wing is supporting for American Antarctic research. It is known that under the Antarctic Treaty no nation is to have military forces in Antarctica. Since the U.S. military in Antarctica is there to support National Science Foundation programs, not as a military force.

3.3 Animal attacks

On 22 July 2003, a female British scientist died on Antarctic Peninsular, after being attacked by a leopard seal. The decedent is Kristy Brown, 28, a qualified and experienced scientific diver of the British Rothera research station. She drowned during a snorkeling expedition when the seal attacked without warning and dragged her underwater. The incident was seen by her male snorkeling buddy and a two-person team watching from the shore. A boat was launched immediately to attempt a rescue. Ms Brown was pulled from the water after several minutes and colleagues tried to revive her on the way back to the Rothera research station, which has a fully equipped medical centre. After attempting cardio-pulmonary resuscitation for nearly an hour, the station's doctor pronounced her dead.

The incident is the first time that a leopard seal is known to have fatally attacked a human being. The animals, which can weigh up to half a tonne and grow to between 12ft and 15ft long, are powerful carnivores that hunt penguins, fish, squid and krill, but, while inquisitive towards human beings; they are rarely aggressive unless provoked. However, according to the investigations from British, Kristy Brown and teammate complied with the safety procedures at that time, and the research station had no misconduct on handling of the matter.

3.4 Shipwreck

3.4.1 Accidents of National Expedition

On 3 December 1987, The Australian Antarctic research ship Nella Dan grounded on rocks when her anchor dragged while transferring fuel to shore in Buckles Bay, Macquarie Island. The ship was blown onto the rocks and was badly holed in one fuel tank, the engine room and a hold. Attempts to salvage the vessel were unsuccessful and a decision was made to scuttle the vessel after valuable scientific equipment had been removed. These plans had to be abandoned when the ship began to list badly and the salvors were forced to leave the ship. Fire subsequently broke out on the ship apparently from overheating diesel generators left on board to operate pumps. Smoking and listing badly, Nella Dan was towed 3 miles out to sea and sank in water over 3000m deep, taking with her over \$400,000 worth of equipment, on 24 December 1987.

In the afternoon of 6 December 2003, three members of South Korea's Antarctic expedition lost connection with their King Sejong Station, on the return from the nearby Chile base on the Antarctic Peninsula. The next afternoon, King Sejong base expedited another five members to search for the tracks of the lost persons. However, for the bad weather, the later team suffered shipwreck and subsequently lost contact with the base, too. On the morning of December 8, rescuers found the later five members on the Ardley Island, including four survivors and one fatality. The decedent is a 27-year-old graduate student of Seoul National University, who died of temperature drops after the capsizing. That night, the previous missing staffs were finally rescued by helicopter of Chile on the Nelson Island, after missing 54 hours. Through hospital treatments, the survivors are in good health.



Figure 4 Australian Antarctic research ship Nella Dan sank

3.4.2 Accidents of Passenger Liner

On 23 November 2007, the MS Explorer struck an iceberg and sank, but all on board were rescued by nearby ships. The MS Explorer was a Liberian-registered cruise ship designed for Arctic and Antarctic service, as the frontrunner for sea-based tourism in that region. The ship impacted submerged ice that put a fist size hole in its hull. The Explorer began to take on water, and 90 minutes later, the captain ordered the

passengers and crew to abandon ship. All 54 passengers and crew launched and manned the lifeboats and were rescued by another cruise ship. Twenty hours after the impact, the MS Explorer slipped beneath the waves near the South Shetland Islands. However, the fuel leaked from the Explorer formed an 8 km long and 5 km wide belt of pollution, causing serious environmental pollution of nearby water.

On 28 December 2007, a Norwegian Liner with 3000 passengers hit the iceberg in Antarctica, due to the power failure, but fortunately no casualties.

On 4 December 2008, the Argentine cruise ship “Ushuaia” ran aground on rocks off the coast of Antarctica. All 122 passengers were rescued by the Chile's military.

On 17 February 2009, A Quark Expeditions ship “Ocean Nova” with 106 crews got stuck in craggy rocks in Antarctica without casualty. According to the company's statement, the ship didn't leak oil or any other hazardous materials into the delicate ecosystem.

In the above cases, contingency plans worked and passengers were safe, but the accidents raise concerns about both the environmental risks posed by the increasing number of vessels, some of which carry thousands of people, and the safety of those passengers.



Figure 5 the MS Explorer sunk in Antarctica

4. Safety precautions

Even today, for an extended journey in Antarctica to succeed, proper equipment and preparation, strong leadership, excellent navigational skills, mental and physical fortitude, and luck are all required. To journey beyond the confines of protective structures means battling the weather on its own terms, and realizing that mistakes can lead to frostbite, hypothermia and death. All the accidents happened in Antarctica are lessons of blood, from which we should absorb much experience for safety precautions.

4.1 Station Safety

4.1.1 outside safety

At Antarctic research stations outside activities are directly dependent upon weather conditions, which are divided into three different categories, based on the level of severity. Even at a permanent base, people don't venture outside for any reason during the most severe conditions, such as wind chills below -50°C or during a blizzard, when blowing snow obscures visibility so much that the next building over becomes invisible.

Field parties are equipped with special clothing designed to withstand the extreme conditions of Antarctica. Yet, even the best of clothing is no substitute for common sense; constant vigilance must be maintained against snow blindness, frostbite or hypothermia. As conditions can deteriorate rapidly, research scientists heading out to do field works carry emergency equipment, such as sleeping bags, radios, stoves, tents, food, and other supplies, even if they are only out for a short trip. Though it might not keep the parties comfortable in horrible weather, it could mean the difference between life and death.

Before researchers and support personnel are allowed to travel to remote sites or onto the sea ice, they must pass a survival training course. Teams based at a permanent research station such as McMurdo are required to check out when leaving the station and check in again upon return. At remote field camps failure to radio the base station at specified intervals can result in search and rescue missions being initiated.

4.1.2 Fire safety

According to the fire history in Antarctica, the electrical fault is the biggest trigger to catch fire, which should attract enough attention. And the smoking should generally forbid in the Antarctic stations.

To prevent the fire, Many Antarctic bases have emergency supplies stored in a hut near to the base but well away so that if the unthinkable happens and the base burns down in the depths of winter when no-one can either get in or out, there should be enough supplies and shelter for the base members to survive until help can arrive. This is a successful experience for the Russian Progress Station to follow this, which help them maintain the normal operation of the station.

The latest fire of Antarctic New Zealand is quickly controlled by the staff there without serious injury. We can consult the fire precaution facilities in Scott Base. Most areas of the base have smoke, heat and sprinkler systems, which along with regular fire drills for all people on base keep fire prevention and awareness at a high level. In case of a major fire sections of Scott Base (the link ways) can be closed off or demolished to prevent the fire from spreading throughout the base. Scott Base retains around 105 000 liters of water at all times for fire fighting as part of its safety procedures. The nearby US McMurdo Station also has a trained fire fighting crew and fire engines. McMurdo and Scott Base fire crews act as back up for each other in cases of fire.

4.2 Flight safety

The level of aircraft activity in Antarctica is negligible compared with that encountered in developed countries. Nevertheless a large number of aircraft have been lost largely as a result of flying or landing in adverse weather conditions or poor visibility. There are a number of air corridors between Antarctica and adjacent countries that are used by the aircraft of several national operators (and occasionally commercial aircraft). There is also significant multi-program, aviation activity in the vicinity of many stations.

In 1989 the Antarctic Treaty Consultative Parties (ATCPs) convened a Meeting of Experts on Air Safety to develop measures that would prevent inter-operator air incidents and improve coordinated search and rescue procedures. One of the principal

outcomes of the meeting was a recommendation that national operators establish a database of aeronautical information, compile an information manual of aircraft facilities in Antarctica and develop appropriate procedures. These tasks were assigned by the ATCPs to Council of Managers of National Antarctic Programs (COMNAP).

4.3 Ship safety

The waters around Antarctica are reputed to be some of the most violent on Earth. Winds circle unobstructed around the continent, whipping up huge waves and causing, at the very least, ship-wide stomach upheavals. Safety is a big issue for researchers and passengers aboard Antarctic vessels. When seas are too rough, deck operations should shut down until conditions improve. Equipment not fastened down can be hurled across a room or thrown overboard. Even during more benign conditions, people working near the sides of the ship are required to wear flotation gear and special clothing designed to keep them from quickly freezing to death should they end up in the water. Safety lines are often required.

Sea ice is a hazard unique to polar seas. Icebergs must be avoided as even small pieces of ice are capable of damaging equipment or jolting passengers. In addition, Antarctic ships are frequently at risk of entrapment in swift-moving pack ice. A sudden wind change can cause seemingly open pack ice to rapidly enclose a ship. Many an expedition vessel has met its fate as a result of being trapped and crushed by the immense pressure of wind-driven ice.

4.4 Tourism safety

The Antarctic tourism industry began in the late 1950s with Chile and Argentina taking more than 500 fare-paying passengers to the South Shetland Islands. The first expedition to Antarctica with travelers was in 1966 and was lead by Lars Eric Lindblad. The modern expedition cruise industry was born shortly after, in 1969, when Lindblad built the first expedition ship MS Explorer. Since 1970 tourist expeditions have regularly ventured to Antarctica every year. The number of tourists has more than quadrupled in the last decade, growing to 45,213 in 2007-08. This includes: seaborne, airborne and land-based tourism.

Over the past couple of years there have been several high profile incidences involving Antarctic cruise ships, including the sinking of the MS Explorer back in 2007, and two ships running aground in December 2008 and again in February of this year. In response to these accidents, the International Association of Antarctica Tour Operators (IAATO) passed a series of actions to enhance marine safety. The changes include mandatory participation in a satellite tracking program for all IAATO members, the conversion of all open lifeboats to partially or fully closed boats, and a new rule that stipulates that all ships sailing below 60° south have "a captain or appointed ice pilot with Antarctic experience." The final new rule is in direct response to an investigation earlier this year that found that the inexperience of the captain directly played a role in the sinking of the Explorer.

The measures adopted are good steps for the Antarctic tourism industry. The changes are not likely to prevent further incidences however, but they may help to ensure that passengers continue to be safe and that they can be located more quickly by rescue crews, should the need arrive. The fact that the IAATO is thinking about sustainable travel to Antarctica is encouraging as well, as it shows that they are moving towards becoming better stewards of the environment and ensuring that the continent remains in pristine condition for future adventure travelers to enjoy as well.

However, the IAATO should have a more general programming to regular the Antarctic tourism, which is not only the seaborne travel but also include the airborne and land-based or air-supported tourism. This overflight operation has occurred since the 1950s. Until the late 1970s, after an estimated 11,000 air-tourists had visited Antarctica, the Air New Zealand plane crashed into Mount Erebus killing 257 crews. Following this disaster, flights ceased and only began again in the mid-1990s. This renewed industry brought over 10,000 additional visitors to Antarctic skies only before the turn of the century, but also with many uncertain security risks. It remains to be seen what kind of plans the IAATO put in place in this area however and how it'll impact the industry as a whole.

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